

What is claimed is:

1. A process liquid supply nozzle, comprising a substantially tubular nozzle provided with a discharge port for discharging a process liquid, a substantially bowl-shaped nozzle holder provided with a through-hole into which the nozzle can be inserted, and a free space formed between an inner circumferential surface of the nozzle holder and an outer circumferential surface of the nozzle, at least a prescribed cleaning liquid being supplied into the free space,

wherein the nozzle holder and the nozzle are relatively movable in a vertical direction such that the process liquid is discharged from the discharge port of the nozzle under the state that the discharge port of the nozzle protrudes downward from the through-hole, and the nozzle is cleaned with a cleaning liquid under the state that the nozzle is housed in the nozzle holder.

2. The process liquid supply nozzle according to claim 1, wherein a gas is supplied into the free space under the state that the nozzle is housed in the nozzle holder.

3. The process liquid supply nozzle according to claim 1, wherein a spiral groove is formed on the inner circumferential surface of the nozzle holder.

4. The process liquid supply nozzle according to claim 1, wherein the outer circumferential surface of

the nozzle is rough and exhibits a hydrophilicity.

5        5. A process liquid supply nozzle, comprising a substantially tubular nozzle provided with a discharge port for discharging a process liquid, a substantially bowl-shaped nozzle holder provided with a hole portion into which the nozzle can be inserted, and a free space formed between an outer circumferential surface of the nozzle and an inner circumferential surface of the nozzle holder, at least a prescribed cleaning liquid  
10        being supplied into the free space,

         wherein the nozzle is arranged to extend through a central portion of the hole portion, and the outer circumferential surface of the nozzle is substantially in a point-to-point contact with a wall of the hole  
15        portion.

         6. The process liquid supply nozzle according to claim 5, wherein the hole portion has a regularly polygonal planar shape, and the outer circumferential surface of the nozzle is substantially in a point-to-  
20        point contact with the wall surface of the hole portion in a midpoint of each side of the regularly polygonal planar shape.

         7. The process liquid supply nozzle according to claim 5, wherein at least one of the nozzle and the  
25        nozzle holder is rotatable by a prescribed angle.

         8. The process liquid supply nozzle according to claim 5, wherein a spiral groove is formed on the inner

circumferential surface of the nozzle holder.

9. The process liquid supply nozzle according to claim 5, wherein the outer circumferential surface of the nozzle is rough and exhibits a hydrophilicity.

5           10. A process liquid supply nozzle, comprising a substantially tubular nozzle provided with a discharge port for discharging a process liquid, a substantially bowl-shaped nozzle holder provided with a through-hole into which the nozzle can be inserted, a plurality of  
10           projections formed in a wall of the through-hole in a manner to project in a radial direction of the through-hole, and a free space formed between an outer circumferential surface of the nozzle and an inner circumferential surface of the nozzle holder, at least  
15           a prescribed cleaning liquid being supplied into the free space,

          wherein the projections are in a point-to-point contact with the outer circumferential surface of the nozzle.

20           11. A process liquid supply nozzle, comprising a substantially tubular nozzle provided with a discharge port for discharging a process liquid, a substantially bowl-shaped nozzle holder provided with a through-hole into which the nozzle can be inserted, a plurality of  
25           projections formed on an outer circumferential surface of the nozzle in a manner to project in a radial direction of the nozzle, and a free space formed

between the outer circumferential surface of the nozzle and an inner circumferential surface of the nozzle holder, at least a prescribed cleaning liquid being supplied into the free space,

5            wherein the projections are in a point-to-point contact with a wall of the through-hole.

12. A process liquid supply device, comprising:  
a process liquid supply nozzle including a substantially tubular nozzle provided with a discharge  
10 port for discharging a process liquid, a substantially bowl-shaped nozzle holder provided with a through-hole into which the nozzle can be inserted, and a free space formed between an inner circumferential surface of the nozzle holder and an outer circumferential surface of  
15 the nozzle;

a process liquid supply mechanism for supplying the process liquid into the nozzle;

a cleaning liquid supply mechanism for supplying a prescribed cleaning liquid into the free space for  
20 cleaning the nozzle; and

a nozzle moving mechanism for relatively moving the nozzle and the nozzle holder in a vertical direction such that the process liquid is discharged from the discharge port of the nozzle under the state  
25 that the discharge port protrudes downward from the through-hole of the nozzle holder or the nozzle is cleaned with the cleaning liquid under the state that

the nozzle is housed in the nozzle holder.

13. The process liquid supply device according to claim 12, further comprising a gas supply mechanism for supplying a prescribed gas into the free space.

5           14. The process liquid supply device according to claim 12, wherein a spiral groove is formed on the inner circumferential surface of the nozzle holder.

15           15. The process liquid supply device according to claim 12, wherein the outer circumferential surface of the nozzle is rough and exhibits a hydrophilicity.

10           16. A process liquid supply device, comprising:  
            a process liquid supply nozzle including a substantially tubular nozzle provided with a discharge port for discharging a prescribed process liquid, a  
15           substantially bowl-shaped nozzle holder provided with a hole portion into which the nozzle can be inserted, and a free space formed between an inner circumferential surface of the nozzle holder and an outer  
20           circumferential surface of the nozzle, the nozzle being arranged to extend through a central portion of the hole portion, and the outer circumferential surface of the nozzle being substantially in a point-to-point contact with a wall of the hole portion;

25           a process liquid supply mechanism for supplying the prescribed process liquid into the nozzle; and

            a cleaning liquid supply mechanism for supplying a prescribed cleaning liquid into the free space for

cleaning the nozzle.

17. The process liquid supply device according to claim 16, wherein the hole portion has a regularly polygonal planar shape, and the outer circumferential surface of the nozzle is in a point-to-point contact with the wall surface of the hole portion in a midpoint of each side of the regularly polygonal planar shape.

18. The process liquid supply device according to claim 16, further comprising a rotating mechanism for rotating at least one of the nozzle and the nozzle holder by a prescribed angle.

19. The process liquid supply device according to claim 16, further comprising a gas supply mechanism for supplying a prescribed gas into the free space.

20. The process liquid supply device according to claim 16, wherein a spiral groove is formed on the inner circumferential surface of the nozzle holder.

21. The process liquid supply device according to claim 16, wherein the outer circumferential surface of the nozzle is rough and exhibits a hydrophilicity.

22. A process liquid supply device, comprising:  
a process liquid supply nozzle including a substantially tubular nozzle provided with a discharge port for discharging a prescribed process liquid, a substantially bowl-shaped nozzle holder provided with a through-hole into which the nozzle can be inserted, a plurality of projections formed on a wall of the

through-hole in a manner to project in a radial direction of the through-hole, and a free space formed between an inner circumferential surface of the nozzle holder and an outer circumferential surface of the nozzle, the nozzle being arranged to extend through a central portion of the through-hole, and the outer circumferential surface of the nozzle being substantially in a point-to-point contact with the projections;

a process liquid supply mechanism for supplying the prescribed process liquid into the nozzle; and

a cleaning liquid supply mechanism for supplying a prescribed cleaning liquid into the free space for cleaning the nozzle.

23. A process liquid supply device, comprising:  
a process liquid supply nozzle including a substantially tubular nozzle provided with a discharge port for discharging a prescribed process liquid, a substantially bowl-shaped nozzle holder provided with a through-hole into which the nozzle can be inserted, a plurality of projections formed on an outer circumferential surface of the nozzle in a manner to project in a radial direction of the nozzle; and a free space formed between an inner circumferential surface of the nozzle holder and the outer circumferential surface of the nozzle, the nozzle being arranged to extend through a central portion of the through-hole,

and the projections being substantially in a point-to-point contact with a wall of the through-hole;

a process liquid supply mechanism for supplying the prescribed process liquid into the nozzle; and

5 a cleaning liquid supply mechanism for supplying a prescribed cleaning liquid into the free space for cleaning the nozzle.

24. A nozzle cleaning method for removing a residual process liquid attached to a substantially tubular nozzle for discharging a prescribed process liquid, comprising the steps of:

housing the nozzle in a substantially bowl-shaped nozzle holder having a through-hole formed in a lower edge portion; and

15 removing the residual process liquid attached to the nozzle by means of supplying a cleaning liquid into a free space formed between an outer circumferential surface of the nozzle and an inner circumferential surface of the nozzle holder and discharging the cleaning liquid from the free space through the through-hole such that a prescribed amount of the cleaning liquid is kept stored in the free space.

25 25. The nozzle cleaning method according to claim 24, wherein a spiral groove is formed on the inner circumferential surface of the nozzle holder, and the cleaning liquid is discharged from the free space while allowing the cleaning liquid to whirl on the outer



circumferential surface of the nozzle along the spiral groove.

26. The nozzle cleaning method according to claim 24, wherein a prescribed gas is also supplied into the free space when the cleaning liquid is supplied into the free space.

27. The nozzle cleaning method according to claim 24, wherein a prescribed gas is supplied into the free space after the step of removing the residual process liquid attached to the outer circumferential surface of the nozzle by supplying the cleaning liquid so as to remove the residual cleaning liquid attached to the outer circumferential surface of the nozzle, thereby drying the outer circumferential surface of the nozzle.

28. A nozzle cleaning method for removing a residual process liquid attached to a substantially tubular nozzle for discharging a prescribed process liquid, comprising:

mounting the nozzle in a substantially bowl-shaped nozzle holder having a through-hole formed in a lower edge portion;

cleaning the nozzle to remove the residual process liquid attached to the nozzle by means of supplying a cleaning liquid into a free space formed between an outer circumferential surface of the nozzle and an inner circumferential surface of the nozzle holder and discharging the cleaning liquid from the free space

through-hole such that a prescribed amount of the cleaning liquid is kept stored in the free space; and

cleaning again the nozzle to remove the remaining process liquid by means of rotating any one of the nozzle and the nozzle holder by a prescribed angle and then supplying again the cleaning liquid into the free space.

29. The nozzle cleaning method according to claim 28, wherein a spiral groove is formed on the inner circumferential surface of the nozzle holder, and the cleaning liquid is discharged from the free space while allowing the cleaning liquid to whirl on the outer circumferential surface of the nozzle along the spiral groove.

30. The nozzle cleaning method according to claim 28, wherein a prescribed gas is also supplied into the free space when the cleaning liquid is supplied into the free space.

31. The nozzle cleaning method according to claim 28, wherein a prescribed gas is supplied into the free space after the step of removing the residual process liquid attached to the outer circumferential surface of the nozzle by supplying the cleaning liquid so as to remove the residual cleaning liquid attached to the outer circumferential surface of the nozzle, thereby drying the outer circumferential surface of the nozzle.